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WENDEROTH, LIND & PONACK, L.L.P.
2033 K STREET N. W.
SUITE 800
WASHINGTON, DC 20006-1021

EXAMINER	
WONG, EDNA	
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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/664,078	NAGAI ET AL.	
	Examiner	Art Unit	
	Edna Wong	1753	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *16 December 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *39 and 42-62* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *39 and 42-62* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☒ Certified copies of the priority documents have been received in Application No. 09/893,624.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

This is in response to the Amendment dated December 16, 2005. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

The **finality** of the rejection of the last Office Action has been withdrawn in view of the new grounds of rejection.

Response to Arguments

Specification

The disclosure has been objected to because of minor informalities.

The objection of the disclosure has been withdrawn in view of Applicants' amendment.

Claim Objections

Claims **39 and 50** have been objected to because of minor informalities.

The objection of claims 39 and 50 has been withdrawn in view of Applicants' amendment.

Claim Rejections - 35 USC § 112

I. Claim **54** has been rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter

which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

The rejection of claim 54 under 35 U.S.C. 112, first paragraph, has been withdrawn in view of Applicants' amendment.

II. Claims **46-47 and 57-60** have been rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The rejection of claims 46-47 and 57-60 under 35 U.S.C. 112, second paragraph, has been withdrawn in view of Applicants' amendment.

Claim Rejections - 35 USC § 103

I. Claims **39-62** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Dordi et al.** (US Patent No. 6,267,853 B1) in combination with **Chen et al.** (US Patent No. 6,565,729 B2) and **Mayer et al.** (US Patent No. 6,309,981 B1).

With regards to claims *40 and 41*, the rejection under 35 U.S.C. 103(a) as being unpatentable over Dordi et al. in combination with Chen et al. and Mayer et al. has been withdrawn in view of Applicants' amendment. Claims 40 and 41 have been cancelled.

With regards to claims *39 and 42-62*, the rejection under 35 U.S.C. 103(a) as

being unpatentable over Dordi et al. in combination with Chen et al. and Mayer et al. is as applied in the Office Action dated August 16, 2005 and incorporated herein. The rejection has been maintained for the following reasons:

Applicants state that the deposition rate of the electrolytic deposition process depends on a current value with no connection to a polarization of the plating liquid. Thus, the deposition rate of the electrolytic process increases in proportion to a current value. According to the present invention, by using as the first plating liquid, a plating liquid which has a high polarization and which allows metal deposition only when a high voltage is applied, metal film can be deposited evenly on the entire wall of the surface of the seed layer having different thickness and deposition potential.

In response, Chen teaches a method for filling a metal into fine recesses in a surface of a substrate. Chen teaches repairing an ultra-thin metal seed layer by electrolytically or electrolessly depositing additional metal on the ultra-thin metal seed layer to provide an enhanced seed layer (col. 6, lines 29-45).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the electroless deposition processing (EDP) described by Dordi with wherein the reinforcing the seed layer is performed by electroplating a surface of the seed layer because electrolytically and electrolessly depositing the seed layer would have been functionally equivalent as taught by Chen (col. 6, lines 29-45).

Chen teaches that a suitable composition and range of concentrations for the

various components of the electrolytic bath solution for *enhancing the seed layer* include the following:

1. Copper sulfate: 0.03M to 0.25M;
2. Complexing agent: complex to metal ratios from 1 to 4;
3. Boric acid: 0.01M to 0.5M; and
4. pH: 5-13 (col. 12, lines 1-15).

Chen teaches that a suitable composition and range of concentrations for the various components of the electrolytic bath solution for *subsequent copper deposition* include the following:

1. 170 g/l H_2SO_4;
2. 17 g/l copper;
3. 70 ppm Chloride; and
4. Organic additives (col. 14, lines 41-51).

Chen teaches a first plating liquid and a second plating liquid that is compositionally the same with the first plating liquid and the second plating liquid as presently claimed. Thus, one having ordinary skill in the art would have reasonably expected that the first plating liquid disclosed by Chen would have inherently had a higher polarization than the second plating liquid as disclosed by Chen. A newly discovered property does not necessarily mean the product is unobvious, since this property may be inherent in the prior art. *In re Best* 195 USPQ 430; *In re Swinehart* 169 USPQ 226.

II. Claims **63-79** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Dordi et al.** (US Patent No. 6,267,853 B1) in combination with **Chen et al.** (US Patent No. 6,565,729 B2) and **Mayer et al.** (US Patent No. 6,309,981 B1).

The rejection of claims 63-79 under 35 U.S.C. 103(a) as being unpatentable over Dordi et al. in combination with Chen et al. and Mayer et al. has been withdrawn in view of Applicants' amendment. Claims 63-79 have been cancelled.

Response to Amendment

Claim Objections

Claims **51, 56 and 61** are objected to because of the following informalities:

Claim 51

line 2, the word "comprising" should be amended to the word -- comprises --.

Claim 56

line 2, the word "comprising" should be amended to the word -- comprises --.

Claim 61

line 2, the word "remove" should be amended to the word -- removing --.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

Claims **52-54 and 58-62** are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 52

line 1, "the first current" lacks antecedent basis.

line 2, it appears that "a current density" is the same as the first current density or the second current density recited in claim 42, lines 2-3. However, it is unclear if it is. If it is not, then what is the relationship between the current density, the first current density and the second current density.

Claim 54

line 1, "the first current" lacks antecedent basis.

Claim 58

line it appears that "an oxidizing agent solution and a silicon oxide film etching agent" are further limiting the etching liquid recited in claim 39, line 14. However, it is unclear if it is. If it is not, then what is the relationship between the oxidizing agent solution and the silicon oxide film etching agent and the etching liquid.

Claim 61

line 3, "the metal layer" lacks antecedent basis.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims **39 and 42-62** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Dordi et al.** (US Patent No. 6,267,853 B1) in combination with **Chen et al.** (US Patent No. 6,565,729 B2), **Mayer et al.** (US Patent No. 6,309,981 B1) and **WO 99/57342** ('342) [**Hongo et al.** (US Patent No. 6,517,894 B1) is used as the WO '342 English equivalent).

Dordi teaches a method for filling a metal into fine recesses in a surface of a substrate, comprising:

(a) providing a substrate having fine recesses (= features) [col. 4, lines 3-6] covered with a seed layer (= seed layer is repaired) in a surface of the substrate (col.12, lines 21-29);

(b) reinforcing the seed layer (= seed layer repair) by contacting the surface of the seed layer in a first plating liquid having ions of a metal (= electroless deposition fluid) [col. 12, lines 21-29 and 56-57; and col. 27, lines 24-25], and then rotating the

substrate to drain away the first plating liquid by the action of centrifugal force (= the pedestal rotates at a faster speed of about 100 to about 500 RPMs as the remaining electroless deposition fluid is rinsed from the substrate and is drained through the outlet and discarded) [col. 14, lines 15-23];

(c) filling said fine recesses (= depositions in features) [col. 4, lines 3-6] with the metal by electroplating a surface of the reinforced seed layer with contacting the substrate in a second plating liquid (col. 27, lines 26-39), and then rotating the substrate to drain away the second plating liquid by the action of centrifugal force (= the head assembly is preferably rotated at a high speed (i.e., >20 rpm) after the head assembly is lifted from the process cell to enhance removal of residual electrolyte on the head assembly) [col. 17, lines 22-33]; and

(d) removing the metal on an edge portion of the substrate (= edge bead removal) by supplying an etching liquid (= an etchant) to a surface of the metal on the edge portion of the substrate (= substantially equal exposure to the etchant at the peripheral portion of the wafer) [col. 10, line 64 to col. 11, line 2; and col. 28, lines 5-17].

The film thickness of the metal on the substrate after the electroplating in the second plating liquid is measured (= improved uniformity of the deposited film to within about 2% (i.e., maximum deviation of deposited film thickness is at about 2% of the average film thickness)) [col. 17, lines 34-44].

Pure water is supplied to replace the etching liquid with pure water and remove the etching liquid (= delivering deionized water to the wafer to rinse the residual etchant

from the wafer) after removing the metal layer on the edge portion of the substrate (col. 11, lines 27-39).

The substrate is dried by spin-drying after the supply of the pure water (= spinning the wafer at a high speed to dry the wafer) [col. 11, lines 27-39].

The method of Dordi differs from the instant invention because Dordi does not disclose the following:

a. Wherein the first plating liquid has a complexing agent, as recited in claim 39.

b. Washing a surface of the metal on the substrate with water or washing liquid comprising water, as recited in claim 39.

c. Wherein the washing of the surface of the metal is performed prior to the removing the metal on the edge portion of the substrate, as recited in claim 39.

d. Wherein said first plating liquid has a higher polarization than said second plating liquid, as recited in claim 39.

e. Wherein the reinforcing the seed layer is performed by electroplating a surface of the seed layer, as recited in claim 39.

f. Wherein the reinforcing in the first plating liquid is performed at a first current density and the electroplating in the second plating liquid is performed at a second current density, as recited in claim 42

g. Wherein the second current density is higher than the first current density,

as recited in claim 43.

h. Annealing the substrate after removing the metal on the edge portion of the substrate, as recited in claim 45.

i. Polishing the surface of the metal on the substrate to remove at least a portion of the metal except an interior of the recesses, as recited in claim 46.

j. Forming a protective film on an exposed surface of the metal after the polishing, as recited in claim 47.

k. Wherein a pH of the first plating liquid is in a range of 7-14, as recited in claim 48.

l. Wherein a concentration of the complexing agent is in range of 0.1-500 g/l, as recited in claim 49.

m. Wherein the complexing agent is selected from the group consisting of ethylenediamine tetracetic acid, ethylenediamine, N,N'N",N'-ethylene-di-nitro-tetrapropane-2-ol, pyrophosphoric acid, iminodiacetic acid, diethylenetriamine pentacetic acid, diethylenetriamine, triethylenetetramine, tetraethylenepentamine, diaminobutane, hydroxyethyl ethylenediamine, ethylenediamine tetrapropionic acid, ethylenediamine tetramethylene phosphonic acid, diethylenetriamine tetramethylene phosphonic acid, and diethylenetriamine pentamethylene phosphonic acid, as recited in claim 50.

n. Wherein the first plating liquid further comprising at least one additive selected from the group consisting of organic acids, amines, glycerin, gelatin, heavy

metal ions, thiazoles, triazoles, thiadiazoles, imidazoles, pyrimidines, sulfonic acids, and glutamic acids, as recited in claim 51.

o. Wherein the first current is a direct current and a current density of the first current is in a range of 0.01 A/dm^2-30 A/dm^2, as recited in claim 52.

p. Wherein the current density of the first current is in a range of 0.1 A/dm^2-3 A/dm^2, as recited in claim 53.

q. Wherein the first current is a pulse current, as recited in claim 54.

r. Wherein a temperature of the first plating liquid is in a range of 10°C-80°C, as recited in claim 55.

s. Wherein the second plating liquid comprising an additive for enhancing a leveling property, as recited in claim 56.

t. Measuring a film thickness of the seed layer on the substrate prior to the electroplating in the first plating liquid, as recited in claim 57.

u. Wherein an oxidizing agent solution and a silicon oxide film etching agent are supplied simultaneously or alternately to a backside of the substrate while removing the metal on the edge portion of the substrate, as recited in claim 58.

v. Wherein the oxidizing agent solution is the same as an oxidizing agent solution contained in the etching liquid, as recited in claim 59.

w. Wherein the supply of the oxidizing agent is stopped first to obtain a hydrophobic surface, or the supply of the silicon oxide film etching agent is stopped first to obtain a water-saturated surface, as recited in claim 60.

Regarding claim 39, like Dordi, Chen teaches a method for filling a metal into fine recesses in a surface of a substrate. Chen teaches that a complexing agent forms a stable complex with copper ions and prevents the precipitation of copper hydroxide (col. 12, lines 20-22).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the first plating liquid described by Dordi with wherein the first plating liquid has a complexing agent because a complexing agent would have formed a stable complex with copper ions and prevented the precipitation of copper hydroxide as taught by Chen (col. 12, lines 20-22).

Regarding claim 39, like Dordi, Mayer teaches a method for filling a metal into fine recesses in a surface of a substrate. Mayer teaches applying deionized water to the front of the wafer and the wafer is spun at about 200-300 rpm in order to pre-rinse **202** the wafer of any particles and contaminants left over from the previous steps (col. 8, lines 46-55; and Fig. 2B).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method described by Dordi by washing a surface of the metal on the substrate with water or washing liquid comprising water, wherein the washing of the surface of the metal is performed prior to the removing the metal on the edge portion of the substrate because any particles and contaminants left over from the previous steps on the front of the wafer would have been removed as

taught by Mayer (col. 8, lines 46-55; and Fig. 2B).

Regarding claim 39, Chen teaches a method for filling a metal into fine recesses in a surface of a substrate. Chen teaches repairing an ultra-thin metal seed layer by *electrolytically or electrolessly depositing* additional metal on the ultra-thin metal seed layer to provide an enhanced seed layer (col. 6, lines 29-45).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the electroless deposition processing (EDP) described by Dordi with wherein the reinforcing the seed layer is performed by electroplating a surface of the seed layer because electrolytically and electrolessly depositing the seed layer would have been functionally equivalent as taught by Chen (col. 6, lines 29-45).

Regarding claim 39, Chen teaches that a suitable composition and range of concentrations for the various components of the electrolytic bath solution for *enhancing the seed layer* include the following:

1. Copper sulfate: 0.03M to 0.25M;
2. Complexing agent: complex to metal ratios from 1 to 4;
3. Boric acid: 0.01M to 0.5M; and
4. pH: 5-13 (col. 12, lines 1-15).

Like Chen, Hongo teaches a method for filling metal into fine recesses in a

surface of a substrate. Hongo teaches using a first plating process and a second plating process (col. 8, lines 48-57). Hongo teaches that a copper pyrophosphate plating solution is widely used because of its close adhesion due to high polarization and layered deposition property. It is possible to use a copper pyrophosphate plating solution as a first layer over a copper seed layer (col. 2, lines 25-35).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the first plating liquid described by Dordi and Chen with wherein said first plating liquid has a higher polarization than said second plating liquid because a copper pyrophosphate plating solution would have provided close adhesion due to high polarization and layered deposition property as taught by Hongo (col. 2, lines 25-35).

Regarding claims 42 and 43, Chen teaches that additional metal is electrolytically bulk deposited on the enhanced seed layer within a principle fluid chamber of a reactor under conditions in which the deposition rate of the electrolytic deposition process is substantially greater than the deposition rate of the process used to repair the metal seed layer (col. 6, lines 33-39).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method described by Dordi with wherein the reinforcing in the first plating liquid is performed at a first current density and the electroplating in the second plating liquid is performed at a second current density

because Chen teaches that additional metal is electrolytically bulk deposited on the enhanced seed layer within a principle fluid chamber of a reactor *under conditions in which the deposition rate of the electrolytic deposition process is substantially greater than the deposition rate of the process used to repair the metal seed layer* (col. 6, lines 33-39). This teaching would have suggested to one having ordinary skill in the art that the second current density is higher than the first current density.

Regarding claim 45, the invention as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method described by Dordi by annealing the substrate after removing the metal on the edge portion of the substrate because rapid thermal anneal chambers are well known in the art, and rapid thermal anneal chambers are typically utilized in substrate processing systems to enhance the properties of the deposited materials as taught by Dordi (col. 24, lines 33-54).

Regarding claim 46, the invention as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method described by Dordi by polishing the surface of the metal on the substrate to remove at least a portion of the metal except an interior of the recesses because chemical mechanical polishing is known in the art to planarize the deposited layers and the dielectric layers to define a conductive interconnect feature as taught by Dordi (col.

1, line 66 to col. 2, line 8).

Regarding claim 47, the invention as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method described by Dordi by forming a protective film on an exposed surface of the metal after the polishing because this is well within the skill of one having ordinary skill in the art to have done dependent upon the intended use of the substrate, particularly to the environment to which the substrate will encounter, which would be most suited for the application of the substrate, absent evidence to the contrary.

Regarding claim 48, Chen teaches a pH of 5-13 (col. 12, line 15).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the first plating liquid described by Dordi and Chen with wherein a pH of the first plating liquid is in a range of 7-14 because the pH of the electrolytic bath solution for enhancing the seed layer would have been in a range of 5-13 as taught by Chen (col. 12, line 15).

Regarding claim 49, Chen teaches that the molar ratio of the complexing agent to copper sulfate in the bath is suitably within the range of 1 to 4 (col. 12, lines 25-30).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the complexing agent described by Dordi and

Chen with wherein a concentration of the complexing agent is in range of 0.1-500 g/l because the concentration of the complexing agent in the electrolytic bath solution for enhancing the seed layer would have been within the range of 1 to 4 as taught by Chen (col. 12, lines 25-30).

Regarding claim 50, Chen teaches that the complexing agent is ethylene diamine tetracetic acid (EDTA), ethylene diamine (ED), citric acid, and their salts (col. 12, lines 20-25).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the complexing agent described by Dordi and Chen with wherein the complexing agent is selected from the group consisting of ethylenediamine tetracetic acid, ethylenediamine, N,N'N",N'-ethylene-di-nitro-tetrapropane-2-ol, pyrophosphoric acid, iminodiacetic acid, diethylenetriamine pentacetic acid, diethylenetriamine, triethylenetetramine, tetraethylenepentamine, diaminobutane, hydroxyethyl ethylenediamine, ethylenediamine tetrapropionic acid, ethylenediamine tetramethylene phosphonic acid, diethylenetriamine tetramethylene phosphonic acid, and diethylenetriamine pentamethylene phosphonic acid because ethylene diamine tetracetic acid (EDTA) and ethylene diamine (ED) are known complexing agents in an electrolytic bath solution for enhancing a seed layer as taught by Chen (col. 12, lines 20-25).

Regarding claim 51, Chen teaches that the complexing agents can be used alone, in combination with one another, or in combination with one or more further complexing agents (col. 12, lines 27-30).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the first plating liquid described by Dordi and Chen with wherein the first plating liquid further comprising at least one additive selected from the group consisting of organic acids, amines, glycerin, gelatin, heavy metal ions, thiazoles, triazoles, thiadiazoles, imidazoles, pyrimidines, sulfonic acids, and glutamic acids because the complexing agents can be used alone, in combination with one another, or in combination with one or more further complexing agents as taught by Chen (col. 12, lines 27-30).

Regarding claim 52, Chen teaches that the current density for electrolytically depositing copper to enhance the copper seed layer can be 1 to 5 mA/cm^2 (col. 12, lines 48-51).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method described by Dordi and Chen with wherein the first current is a direct current and a current density of the first current is in a range of 0.01 A/dm^2-30 A/dm^2 because the current density for electrolytically depositing copper to enhance the copper seed layer would have been 1 to 5 mA/cm^2 as taught by Chen (col. 12, lines 48-51).

Regarding claim 53, Chen teaches that the current density for electrolytically depositing copper to enhance the copper seed layer can be 1 to 5 mA/cm^2 (col. 12, lines 48-51).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method described by Dordi and Chen with wherein the current density of the first current is in a range of 0.1 A/dm^2-3 A/dm^2 because the current density for electrolytically depositing copper to enhance the copper seed layer would have been 1 to 5 mA/cm^2 as taught by Chen (col. 12, lines 48-51).

Furthermore, changes to the first current is not deemed a patentable modification; however, such changes may impart patentability to a process if the ranges claimed produce new and unexpected results which are different in kind and not merely in degree from results of the prior art, such ranges are termed "critical" ranges and Applicant has the burden of proving such criticality; even though Applicant's modification results in great improvement and utility over the prior art, it may still not be patentable if the modification was within capabilities of one skilled in the art; more particularly, where general conditions of the claim are disclosed in the prior art, it is not inventive to discover optimum or workable ranges by routine experimentation.

Regarding claim 54, Chen teaches that the current density for electrolytically depositing copper to enhance the copper seed layer can be 1 to 5 mA/cm^2. The plating waveform may be, for example, a forward periodic pulse having a period of 2 msec at

50% duty cycle (col. 12, lines 48-51).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the current described by Dordi and Chen with wherein the first current is a pulse current because the current density for electrolytically depositing copper to enhance the copper seed layer would have been a pulse current in the range of 1 to 5 mA/cm^2 as taught by Chen (col. 12, lines 48-51).

Regarding claim 55, Chen teaches that the temperature of the electrolytic bath solution for enhancing the seed layer is within the range of 20-35°C (col. 12, lines 46-48).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the first plating liquid described by Dordi and Chen with wherein a temperature of the first plating liquid is in a range of 10°C-80°C because the temperature of the electrolytic bath solution for enhancing the seed layer would have been within the range of 20-35°C as taught by Chen (col. 12, lines 46-48).

Regarding claim 56, Chen teaches that in an acid environment, one suitable copper bath comprises organic additives which may include levelers, brighteners, wetting agents and ductility enhancers (col. 14, lines 32-56).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the second plating liquid described by Dordi with

wherein the second plating liquid comprising an additive for enhancing a leveling property because a leveler would have produced the desired film characteristics and provided better filling of the recessed structures on the wafer surface as taught by Chen (col. 14, lines 32-56).

Regarding claim 57, Chen teaches an ultra-thin seed layer having a thickness of about 50 to about 500 Angstroms (col. 10, lines 25-36).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method described by Dordi by measuring a film thickness of the seed layer on the substrate prior to the electroplating in the first plating liquid because one having ordinary skill in the art has the skill to have measured the thickness of the repaired of the seed layer to make sure that it is in the desired thickness.

Regarding claim 58, Mayer teaches that PVD metal typically coats the front edge area outside the active the active circuit region, as well as the side edge, and to some degree the backside (col. 1, lines 59-65). The same etchant under viscous flow conditions provides for removing metal from the side edge and backside edge areas. Spraying of an etchant provides for removal of metal from the backside of the wafer (col. 3, lines 10-20).

It would have been obvious to one having ordinary skill in the art at the time the

invention was made to have modified the removing described by Dordi with wherein an oxidizing agent solution and a silicon oxide film etching agent are supplied simultaneously or alternately to a backside of the substrate while removing the metal on the edge portion of the substrate because the edge and the backside of the wafer are undesired areas to plate as taught by Mayer (col. 1, lines 59-65; and col. 3, lines 10-20).

Mayer teaches that the etchant may be an aqueous sulfuric acid and hydrogen peroxide mixture (col. 3, lines 4-5; and col. 12, lines 15-19). The hydrogen peroxide would have been the oxidizing agent solution and the silicon oxide film etching agent, unless proven otherwise.

Regarding claim 59, Mayer teaches that PVD metal typically coats the front edge area outside the active the active circuit region, as well as the side edge, and to some degree the backside (col. 1, lines 59-65). The *same etchant* under viscous flow conditions provides for removing metal from the side edge and backside edge areas. Spraying of an etchant provides for removal of metal from the backside of the wafer (col. 3, lines 10-20).

Mayer teaches that the etchant may be an aqueous sulfuric acid and hydrogen peroxide mixture (col. 3, lines 4-5; and col. 12, lines 15-19).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the etching liquid described by Dordi and Mayer with wherein the oxidizing agent solution is the same as an oxidizing agent solution

contained in the etching liquid because the same etchant under viscous flow conditions provides for removing metal from the side edge and backside edge areas as taught by Mayer (col. 1, lines 59-65; and col. 3, lines 10-20).

It would have been doing the same endeavor.

Regarding claim 60, the invention as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method described by Dordi and Mayer with wherein the supply of the oxidizing agent is stopped first to obtain a hydrophobic surface, or the supply of the silicon oxide film etching agent is stopped first to obtain a water-saturated surface because the transpositioning of varying steps, or varying the details of a process, as by adding a step or splitting one step into two does not avoid obviousness where the processes are substantially identical or equivalent in terms of function, manner and result. *General Foods Corp. v. Perk Foods Co.* (DC NIII 1968) (157 USPQ 14); *Malignani v. Germania Electric Lamp Co.*, 169 F. 299, 301 (D.N.J. 1909); *Matrix Contrast Corp. v. George Kellar*, 34 F.2d 510, 512, 2 USPQ 400, 402-403 (E.D.N.Y 1929); *Hammerschlag Mfg. Co. v. Bancroft*, 32 F. 585, 589 (N.D.Ill.1887); *Procter & Gamble Mfg. Co. v. Refining*, 135 F.2d 900, 909, 57 USPQ 505, 513-514 (4th Cir. 1943); *Matherson-Selig Co. v. Carl Gorr Color Gard, Inc.*, 154 USPQ 265, 276 (N.D.Ill.1967).

Any inquiry concerning this communication or earlier communications from the

examiner should be directed to Edna Wong whose telephone number is (571) 272-1349. The examiner can normally be reached on Mon-Fri 7:30 am to 4:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (571) 272-1342. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Edna Wong
Primary Examiner
Art Unit 1753

EW
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